

Testing the HELL-SYAC method
of Training for Sleep Discipline

Submitted to
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Technical proposal

prepared for

Major General Robert M. Elton

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1 Executive Summary

1-1 Understanding the Problem

There is a need to provide a test of the HEMI-SYNC method of training for sleep discipline. We are committed to providing outstanding performance in all areas of this effort, and offer a superior and unique combination of relevant experience in sleep technology, knowledge of human performance, training methods, and research evaluation. The scientific-technical capabilities of our project team, their understanding of the problem, and their unique approach to the solution are outstanding.

The US Army has been systematically preparing for a modern battlefield of unparalleled lethality and fluidity that has required fundamental re-evaluation and re-organization of resources.

Thorough studies of military forces and tactics ^{are} ~~has~~ been conducted.

Battlefield scenarios have been developed and revised. It is timely that the US Army should seek to apply all human technologies that will extend the capabilities and performance of soldiers, both as individuals and as tactical groups. The pivot for combat success is with the soldiers, the human dimension in the combat equation, who will fight to win, and survive, to fight and win, again and again.

There is a combat requirement for sleep discipline. The requirement is to develop an effective (doctrinal) training methodology to prepare troops to fight, survive, and win under sustained battle conditions. Commanders must specifically address and implement appropriate rest doctrine for their troops and for themselves. This proposal offers a test of a methodology that commanders can use to prepare strategically for sleep discipline under tactical conditions of continuous operations.

We acknowledge that there is a gap existing between scientific technologies and their application in the US Army. Part of the problem is that available "high tech" approaches must be translated into workable, usable, testable doctrine. This doctrine needs to be tested (demonstrated) in the daily lives of tactical leaders and soldiers. The High Technology Test Bed is the opportunity for introducing HEMI-SYNC as the "how to" for sleep discipline in the US Army.

1.2 Technical Approach

✓ ~~MAIS~~ ^{MIAS} is dedicated to the notion that ultimately it is people, individually and in concert, who determine the effectiveness, efficiency, and efficiency of any organization. We understand that human capability is a variable resource that must be maximized to enhance the tactical performance of combat units and weapon systems. Modern warfare will involve soldiers in continuous operations. Relation and replacement, will, of necessity, provide only limited human resources as the battle continues. Soldier performance under continuous operations requires:

- o enhance the prevention and amelioration of performance decrements caused by interruptions in "normal" sleeping/waking cycles.
- o enhance voluntary sleep induction in individual soldier.
- , o enhance the sleep-rest ratios for individual soldiers.

1.3 Management Approach

The professional experience of our staff motivates a sense of urgency for the Army's concerns. As experienced systems analysts, and researchers, we take an applied approach to conducting this effort to ensure that we are not only generate efficient results, but also ensure that those results are usable by the Army. We have assembled a talented balanced team that is fully capable of delivering the desired products in a timely manner as we are committed to providing outstanding performance in all areas of this contract.

As advocates of the systems approach we prefer a detailed functional analysis and we rely on a detailed work breakdown structure as a critical tool in presenting our methodology. The work breakdown structure translates directly to the allocation of resources, budgeting, and costs. The major milestones that we propose are shown as major end items on the work breakdown structure.

2 - UNDERSTANDING OF THE PROBLEM

2.1 FORCE MODERNIZATION

The Army is systematically preparing for a modern battlefield of unparalleled lethality, indicated by a new order of magnitude in threat and weapons systems capabilities. New tactical issues of the combined arms concept have required fundamental re-evaluation and re-organization of the Army's resources to meet its primary operational mission.

Force Modernization involves revolutionary responses to the probable needs of land battle. Technological developments have included:

- o new automated weapons systems, infrared, microwave, and laser guidance capabilities; radio-optical binoculars, electronic warfare measures, and electronic countermeasures.

Through studies of military forces and tactics have been conducted. Battle scenarios, ranging from theater-nuclear/biochemical/EW attacks to more conventional programs have been developed. Through such intense, coordinated, anticipatory actions, the Army has sought to accurately foresee modern warfare and provide a more powerful alternative to previous methods, organizations, and tactics.

The recognition of the need to provide for various contingencies has been translated into fundamental concepts. A "worst case" conflict would

subsume most other (lesser) conflicts. For example, "fight outnumbered and win" and "win the first battle or lose the war" are both statements that encompass a myriad of potential struggles. To successfully provide a deterrent, forces must be visibly usable in order for an adversary to perceive grave consequences. Effective preparation for war is not merely an accumulation of hardware or a reorganization of structure; but rather, an improvement of the Army's fundamental resource, the individual soldier. (The key element to any weapons system's effectiveness.)

It is, therefore, timely that the U.S. Army should seek to further extend the modern warrior in terms of capabilities, individually and as tactical groups. There are concurrent and overlapping efforts by Army organizations that are mutually coactive and supportive regarding long-range programs. For example, the U.S. Army Soldier Support Center's (SSC) Soldier Developments Division is involved in joint efforts with the Walter Reed Army Institute of Research and the Army Research Institute for the Behavioral and Social Sciences, to produce a test field manual on Soldier Performance in Continuous Operations.

2.2 Extending Soldier Performance

This proposal relates directly to the requirement for extending soldier performance in battle. The short-notice, come-as-you-are, front-line-is-everywhere, battle will be determined ultimately by the Human Dimension. One may cite Xenophon, Napoleon, DuPicq, Patton, SLA Marshall, or Pyle, but the final summation is: The ultimate combat multiplier is not tactics or

weapons; it is the soldier. A basic component of the human side of the combat equation is extending soldier performance. Materiel and tactics can only take us so far. We need to bring out the most, in terms of motivation and ability. In addition, we must be aware of resource limitations. Extending human performance includes keeping the soldier alive and well, alert and fit, for extended periods.

2.2 Continuous Operations

Continuous land combat is an advanced warfare concept that is made possible by the almost complete mechanization of land combat forces and by the technology that enables effective movement at night, in poor weather, and other low visibility conditions. Combat can and will continue around the clock, at the same level of high intensity, for extended periods. Armies now have the potential to fight without letting up. The reasons that have traditionally forced a pause--darkness and resupply--have been largely overcome by technological advances.

2.4 Descriptions by S.L.A. Marshall

The conditions to be expected in continuous operations on the future battlefield have never before been encountered by any army. Perhaps one parallel is the experience of the airborne division whose night drop into Normandy preceded the Allied assault on the beaches in World War II. They were elite troops, all volunteers, and were exceedingly well trained. Nonetheless, their ability to cope was strained since they had not been prepared

for the conditions they encountered.

Initially, the parachute drops were made during the night, zones were missed and many men landed in a marsh.

Only the soldier who had landed in the marsh seemed relatively alert; soaked and shivering, they had to keep moving for warmth. It was different with the men who had landed dry; some of them fell asleep standing, while Ballard talked to them, then fell headlong. When the formation pulled away from the assembly area, then paused briefly, Ballard saw men fall in their tracks and hit the ground with their eyes closed.

Later "Item Company" was caught unawares by a German divebombing and strafing attack. Overpressure from exploding bombs affected virtually all personnel.

Lieutenant Robert G. Burns found he could not keep his men awake no matter how he tried. Some were in heavy sleep within two minutes of the bombing. It confused Burns; he could not tell which were the sleepers and which the wounded and dying. He saw men who, having tumbled down the bank, lay still with their bodies half in water. He went to them, thinking they had been hit, then discovered

they were sleepers who had rolled down the bank and had not awakened when they slipped into the frigid marsh. Others lay there in their jumpsuits, wet through and through, yet sleeping the torpid sleep of utter exhaustion. Officers gave over any attempt to rouse these men. Item Company had become a cipher in the column.

After several days of continuous operations, without sleep, and exceedingly adverse conditions:

They were dull-eyed, bodily worn and too tired to think connectedly. Even a 30-minute flop on the turf with the stars for a blanket would have doubled the power of this body and quickened the minds of its leaders to ideas on which they had blanked out. But no one thought to take that precaution. The United States Army is indifferent toward common-sense rules by which the energy of men may be conserved in combat. These men had too little time to find their positions and check their weapons. Said Captain Patch of his people on the far right, "They were so beat that they could not understand words even if an order was clearly expressed. I was too tired to talk straight. Nothing I heard made a firm impression on me. I spoke jerkily in phrases because I could not remember the thoughts which had preceded what

I said."

The U.S. Army and its leadership at all levels cannot allow this situation to be repeated in the future.

2.5 Decline of Performance in Continuous Operations.

Military leaders have long been aware that their soldier resources shrink in combat. However, they have tended to view this decline purely in terms of the number of soldiers no longer available for duty:

- o Killed in Action
- o Wounded in Action
- o Noncombat Losses
- o Illness

Soldier resources are further reduced when a unit's personnel are not capable of performing their tasks adequately. Degradation of soldiers' performance means that they retain only a proportion (percentage) of their initial effectiveness. Continuous, unrelieved combat will degrade performance and erode soldier resources. Combat capability will be cut whether the unit is 50% strength, or full strength with soldiers who are only 50% effective.

EFFECTS OF PROLONGED CONTINUOUS OPERATIONS ON SOLDIERS' PERFORMANCE

- o Slowed Responding. The soldier is slow to respond to events. For example, there is a delay in translating a simple order into action.
- o Increasing Omissions. The soldier begins to skip tasks. For example, he fails to perform weapons checks.
- o Encoding/Decoding Difficulties. The soldier finds it difficult to transform data or to process information. For example, map/chart coordinates are encoded/decoded slowly, and mistakes are made.
- o Fuzzy Reasoning. The soldier's thinking or reasoning becomes slow and confused. For example, even simple tactical situations cannot be assessed.
- o Communication Difficulties. Increasingly, the soldier has difficulty in deciding what needs to be said, how to say it, or what was said by someone else. For example, the sol-

dier cannot formulate a coherent message and omits important information in issuing spot, status, or damage reports.

- o Mood Changes. Significant changes in mood normally accompany performance degradation. These may include increased irritability, but will be mainly in the direction of depression and apathy.
- o Decreased Vigilance. The soldier is less and less alert. For example, he fails to detect the appearance of targets.
- o Reduced Attention. The soldier is slow to notice changes of conditions or in the overall environment. For example, he is slow to notice hand signals or moving "bushes."
- o Slowed Perception. The soldier is slow in making sense out of things seen or heard, and especially of patterns. For example, he is slow to interpret the significance of changes in enemy fire patterns.

- o Inability to Concentrate. The soldier cannot keep his mind on momentary activity. For example, he cannot follow complex directions or perform numerical calculations. He is confused.
- o Faulty Memory. The soldier's short-term memory (for recent events) is faulty. For example, recent target data elements cannot be recalled or are recalled incorrectly.
- o Slowed Comprehension. The soldier takes longer and longer to understand oral, written, or coded information. For example, he may take a long time to find a location on a map.

Performance can be supported, both strategically and tactically. Leadership, as always, is the key. In the face of radical change in technology, leadership is critical.

2.6 LEADERSHIP. Leadership has a major role to play in continuous operations; leaders match^e men and the pace of their performance to the demands of the situation. This role assumes particular importance when replacements are at a premium, or simply unavailable. Appropriate management of fatigue is a leadership function that cannot be denied. Work/rest discipline be-

comes an important issue in force conservation whenever soldiers must extend their activities. Under these conditions, leaders must not only be concerned with how soldiers do their work, but with how they take their rest as well.

We need to develop an effective training methodology to prepare troops to fight, survive, and win under continuous battle conditions. Commanders must specifically address and implement appropriate rest doctrine for their troops and for themselves.

2.7 WORK AND REST

In general, the rate at which individual resources are expended increases as work increases. Rest restores resources; if fatigue is matched by rest, then the equation balances and a particular work/rest schedule can be expected to be maintained itself indefinitely. If, on the other hand, fatigue exceeds restoration, a deficit accrues. Typically, the imbalance requires longer periods of rest, perhaps days. Serious energy deficits may require weeks of altered activity to achieve full restoration.

Attrition of the force and the absence of replacements provides a set of conditions under which the performance/restoration equation cannot be balanced. Fatigue will mount and the rate of fatigue related casualties will increase as operations are sustained over time. Realistic planning requires that close attention be paid to minimizing the rate of increase of fatigue related casualties. (It is wishful thinking to believe that such casualties

can be eliminated.)

Historically, commanders have resorted to a variety of shiftwork schemes in order to fulfill mission requirements. Perhaps the most familiar of these is the maritime watch system that employs basic four hour duty periods that alternate around the clock. This system also employs two short watches called dog watches that have the effect of cycling a crewmember's work periods through every hour of the day and night over a period of time. Two and four hour guard duty rotations have also been used.

The soldier who cannot take full advantage of all opportunities to rest is not only spending his resources without purpose, but is incurring an additional fatigue debt that will limit his future performance. (While this is relevant for all soldiers, it is especially important for commanders and leaders who bear special responsibility for the care of their troops.) The accumulation of sleep debt over time awake is inexorable.

2.8 Sleep Discipline

The capacities to sustain intellectual and cognitive effort, to maintain appropriate affect, and to accomplish hard physical work all degrade as a joint function of the intensity and duration of combat. Commanders and leaders must recognize and understand the operation of these factors and make their control an integral part of the preparation for and conduct of warfare. The uniqueness of sustained warfare, as currently conceptualized, lies in the expectation of quantum leaps in combat intensity, a dramatic collapse in the time dimension of war, and the introduction of new technological capacities. Development of control principles appropriate for the

sustained battle is required.

Intense fatigue will be a critical factor affecting performance in all military organizations and at all levels within organizations. The distribution of work and rest is a critical issue in the management and control of human resources. No single work/rest doctrine, appropriate for the entire range of expected conditions, can be recommended. An empirical and pragmatic approach, closely coupled with intensive training for continuous operations is required.

Research concerned with the biological basis of sleep is being accelerated. Particular attention is being paid to the role of fragmentary sleep (of varying duration, taken at odd hours, under adverse conditions, etc.) in the maintenance of performance. The value of this research program is that it provides a basis for the development of an effective sleep discipline for use on the battlefield. Unit-specific sleep/rest plans must be developed. (Leaders must be the first to comply with the implementation.)

The most reliable remedy for loss of sleep is sleep itself. Sleep loss and its consequences become the dominant problem after 48 hours of continuous operations. Therefore, sleep discipline is of prime importance. The following priorities are advisable:

1. Leaders, on whose decisions mission success and unit survival depend, must be given the highest priority and the largest allocation of sleep. ~~Military tradition to the contrary, leaders must have an~~

2. The next highest priority must go to soldiers whose responsibilities require them to perform important calculations, make judgements, or evaluate information.
3. A high priority must be given, also, to soldiers who must perform vigilance tasks such as sentries and radar operators.
4. Among the remainder, opportunities for sleep must be allocated as evenly as possible.

In combat, implementation of unit-specific work/rest/sleep discipline is essential for sustaining effectiveness as long as possible. A plan must be developed for duty rotation and shift-work which will provide the management framework for the discipline in combat.

In continuous operations, demands for continuous performance will exist not only for combat troops, but also for combat support and combat service support units. While combat units may have virtually no control over their work schedules, some degree of control may remain for the other types of units. Control can be exercised by selecting appropriate work schedules.

- o For up to five days almost any work-rest schedule (e.g., 2 on-2 off, 4 on-4 off, 8 on-8 off) will sustain performance equally well
- o For up to 30 days follow a 4 on-4 off, or a 16 on-8 off

schedule.

- o Avoid a 4 on-2 off schedule, if possible.

When initiating demanding work schedules, it is important to achieve adaptation of wake/sleep cycles as quickly as possible. For example, after eastbound flights, it is desirable to begin the work phase immediately. This assures that the soldier will be sufficiently tired to sleep during the off-duty phase. If possible, establish the anticipated destination work/rest schedule prior to departure.

A prolonged work period should be preceded by some 12 hours of sleep and complete rest.

→ Sleep discipline must be strictly and constantly enforced.

→ Assure that all soldiers ~~know how to make the most of their rest opportunities. Emphasize to your soldiers that they~~ waste no time in getting to sleep and that they stay asleep.

Undisturbed and prolonged sleep is the most desirable use of rest opportunities. When extended sleep is not possible, even the briefest "cat nap" can be useful. When cat napping is impractical, use relaxation techniques. When there has been mainly sleep loss, but little physical exertion (e.g., manning communications, operating radar) mild physical exercise such as walking around can help to maintain alertness.

The time required for complete recovery from the effects of extended loss of sleep is as follows:

- o As much as 120 hours following 96 or more hours of complete sleep loss
- o 12 hours sleep-rest after 36-48 hours of complete sleep loss with light to moderate workload (subjective fatigue may linger for three days)
- o 24 hours sleep-rest after 36-48 hours sleep loss with high workload (12-16 hours per day)
- o Two to three days time off after 72 hours or more acute sleep loss
- o Three to five days to initiate biological adaptation and return to normal day/night cycle from night shift work
- o Three to four weeks for full adaptation of biological rhythms to atypical work-rest schedules (as in night shift work).

2.9 Technology Gap

The US Army is undergoing a fundamental change of direction. The systematic preparation for the modern battlefield is comprehensive. The battlefield scenarios reflect new equipment and new tactics. The scenarios indicate a need for a capability for continuous operations. Echeloned attack, night vision technology, and electronic warfare will increase the number of combat pulses per day experienced by the forward maneuver elements. The three to six pulses of combat per day experienced during the heavy combat in WWII can be expected to increase to nine to twelve pulses per day on the prospective battlefield. This increased temporal density of combat will create an increased performance demand on all combat and combat support elements. The effect will be to force support elements into a sustained or continuous mode of operations. The operational requirement to repair damaged equipment in or very near to the forward area of engagement will expose support elements to near combat conditions. Under these conditions, the exposure to casualties and fatigue that have always been the lot of the front-line soldier will penetrate more deeply into the force than has hitherto been the case except during major retreats and these conditions will be prolonged; the operations will be continuous. There is a combat requirement for sustaining soldier performance in continuous operations. There is a requirement for sleep discipline.

3 TECHNICAL APPROACH

3.1 Continuous operations in battle; sleep loss and fatigue; performance decrement prevention and remediation.

3.2 Sleep discipline

schedules

sleep induction

sleep conditioning (individual control)

3.3 Technology gap in the US Army

1835, Binaural Beats

Frequency following response

Hemisphereic Synchronization

Brain wave phenomena

sleep

3.4 Training Concept

Conditioned associations

Pavlov and psychic secretions

Biofeedback

3.5 Training Program

front end analysis

development of treatments

application sequence

orientation and induction .
conditioned association ..
volunteer^{ary} control

3.6 Test and Evaluation Program

meeting the requirements

schematic experimental design

measurement criteria

DATA COLLECTION

4 ~~Contract~~^c Statement of Work

4.1 Scope

4.2 Tasks (Workscope or work breakdown structure)

4.3 Reporting Requirements

5 Management Approach

5.1 Project organization (org chart)

5.1.1 Project control

5.2 Personnel descriptions (project team)

5.3 Workscope or WBS

5.3.1 Facilities

5.3.2 Schedules

5.3.3 Orientation briefing

5.4 Program management

5.4.1 Weekly contact with COR

5.4.2 Progress reports

5.5 Support required

6 Bibliography

6.1 Continuous Operations

6.2 Sleep Discipline